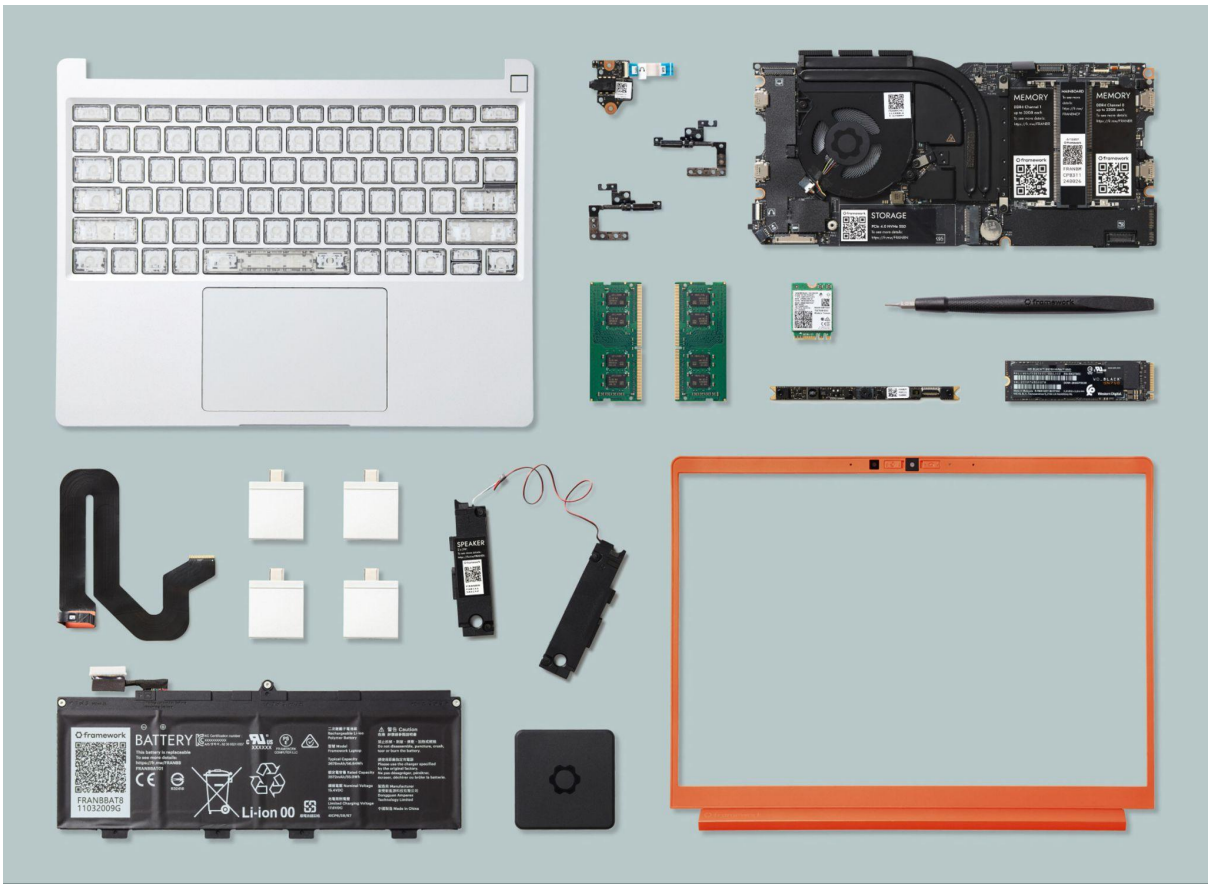
Research report of R. Cavdar



Amsterdam University of Applied Sciences

The future is modular; how Framework Computer, Inc. challenges tech ethics

An ethical analysis of Framework and their goal of repairability, upgradability, sustainability, and their fight against e-waste and planned obsolescence.

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Summary

Exemple

Table of contents

1. Introduction..... 4
Throwaway culture..... 4
The case..... 5
Summary..... 6
2. The facts..... 6
3. Technologies..... 8
The house analogy..... 8
Not everything is open source..... 9
4. Stakeholders..... 10
Parties directly involved..... 10
Parties indirectly involved..... 10
5. Norms and values..... 11
Norms..... 11
Values..... 12
6. Impact on micro, meso and macro..... 12
7. Conclusion..... 12
8. Literature and reference list..... 13

1. Introduction

My name is Remzi Cavdar, I'm 30 years old and a student at the Amsterdam University of Applied Sciences (AUAS) where I'm studying HBO-ICT Software Engineering. I'm in my second year.

Ten years ago, I was careless about throwing things away, except food. Due to my upbringing and beliefs, I never casually discarded food and felt it was wasteful. However, I needed to be more careful with my belongings, and many of my items would often break. I frequently bought cheap, unnecessary things and then threw them away. I was fully immersed in the throwaway culture. After a few years, I became more aware and realised the waste of money and the environmental impact. I started asking myself questions like: Do I need this? And if it were for entertainment, I'd ask: How often will I use it? I wouldn't buy it if the answer to both questions were 'no'.

Now, I live more sustainably than I did ten years ago. I began buying more expensive shoes and clothes that last longer. I also purchase higher quality electronics, so they last a long time. I read reviews, visit price comparison websites, and research to determine the best purchases and how long items will last.

Throwaway culture

In the age of rapidly advancing technology, the shelves of electronic stores are lined with the latest gadgets promising innovative features and groundbreaking advancements. However, there is a darker aspect to this relentless drive for the newest device — the staggering amount of e-waste generated and the underlying culture of planned obsolescence that propels it. A significant fraction of the electronic devices discarded are still functional or would be with minor repairs. Yet, the prevailing business models encourage consumers to replace rather than repair. This consumer behaviour, shaped by industry practices, poses serious ethical and environmental concerns.

Companies promote these practices by rendering repairs costly (even for a single chip or screen) and creating a hostage situation by limiting the parts available for purchase by repair shops and others. These anti-competitive practices are seldom enforced, and while most behaviours are legal, they are patently unethical and ought to be illegal.

Enter the Framework 13 laptop, introduced in July 2021—a beacon of hope in this landscape. Designed with modularity at its core, Framework has introduced a product and championed a philosophy. Their laptop embodies upgradability and sustainability, representing a direct challenge to the ingrained practices of planned obsolescence and the rising tide of e-waste.

This research report embarks on dissecting the ethical dimensions of Framework's approach, exploring its implications for consumers, the tech industry, and our environment.

The case

Framework is a company dedicated to selling repairable, upgradable and sustainable products. They say on their website, 'Consumer electronics is broken.' Framework provides products that are easily repairable and upgradable. For instance, the Framework Laptop 13, introduced in July 2021, was fully repairable, upgradable, and modular. Later, in March 2023, Framework unveiled the Laptop 16, which features an extension bay for the discrete GPU (Framework Computer, Inc., 2023). It's the first laptop to offer an upgradable GPU slot. Framework also strives to raise awareness in the industry and among consumers. They actively participate in various 'right to repair' campaigns, advocating for a world where electronics have a longer lifespan, making them more sustainable (Framework Computer, Inc., n.d.-a).

By encouraging customers to repair or upgrade their laptops rather than replace them entirely, there's a potential reduction in electronic waste. Furthermore, customers can replace or repair parts of their laptop. For those who opt for a motherboard upgrade, Framework, in collaboration with Cooler Master, provides a transparent case for the old mainboards. This allows the Framework Laptop 13 Mainboard to be repurposed as a standalone PC, home server, or storage unit, like a home NAS (Framework Computer, Inc., n.d.-b).

This sustainable approach emphasises Framework's commitment to providing durable products at prices that are truly worth the investment. Additionally, Framework stands out with its open-source bootloader and firmware for the hardware, and also offers support for certain Linux distributions. While their laptops might come at a premium compared to competitors with similar hardware specifications, the combination of repairability, upgradability, customisability, open-source elements, and support for Linux makes them a really valuable choice. The startup sets a commendable example, illustrating the transformative changes needed in the tech industry for a far more eco-friendly future.

Framework made it clear that they have adopted standard laptop dimensions and that they will take those dimensions into account when designing a new motherboard. One unique feature is the laptop's 'Port Expansion Cards,' which are essentially plug-and-play modules that allow users to change or add different ports to their laptop. Not only can customers purchase these Port Expansion Cards directly from Framework's website, but they're also repairable. Even more interestingly, Framework has made the design of these port cards open source. This means they've publicly shared the design specifications, allowing anyone to create their own custom port cards. In fact, some individuals have already done just that!

As of now, these laptops aren't available through third-party sellers, and there's no indication if Framework plans to explore this option in the future.

Summary

Framework Computer, Inc., founded in January 2020 by Nirav Patel, a former Head of Hardware at Oculus, is dedicated to producing laptops tailored for those seeking easily repairable, upgradeable, and customisable products. Their philosophy promotes both long-term financial savings for customers and environmental benefits. An additional advantage of longer usage of their products is that fewer rare minerals and scarce raw materials need to be used and this ensures that fewer children are exploited working in the mines where those minerals and materials come from.

Framework laptops are designed with customisability in mind. Not only can parts be upgraded, but the entire motherboard can also be swapped out when a new Framework series is launched. Furthermore, old motherboards can be repurposed with the provision of a case.

Customers can purchase these laptops directly from Framework's website. The company operates on a batch-shipping model, sending out orders based on when they are placed. At the end of July 2021, Framework had begun deliveries of its inaugural product, the Framework Laptop 13. Since then, 3 generations have been shipped of the Framework 13 series. Framework also introduced and shipped AMD CPU laptops for the Framework 13 series in October 2023, before then customers could only choose Intel processors. On March 23, 2023, they unveiled the Framework Laptop 16, which was made available for preorder, with shipping commencing in the fourth quarter. Presently, the Framework Laptop 16 is being dispatched to customers in batches.

Financially, Framework secured a $9 million seed round in the first half of 2021. YouTuber Linus Sebastian, having previously praised the 11th Gen Intel Framework Laptop 13, invested $225,000 in the company in September of the same year. In January 2022, the company raised an additional $18 million in a Series A round led by Spark Capital.

2. The facts

Nirav Patel observed that many laptops are discarded when they malfunction, often because repairing or replacing a single part, like a screen, can either be more expensive than buying a new laptop or isn’t even economical for the customer when comparing cost and benefit. Mr. Patel recognized that such practices are not only environmentally wasteful but also unsustainable in the long term. As resources on our planet become scarcer and more countries continue to develop, this approach could lead to shortages and place significant strain on the environment.

Mr. Patel, having studied Electrical and Computer Engineering at Carnegie Mellon University from 2005 to 2009, gained valuable experience working at notable tech companies like Apple, Oculus, and Meta (formerly Facebook). With this background, he recognized a gap in the laptop market. Unlike most offerings from established companies, he envisioned a laptop that prioritised repairability, upgradability, and customisability. To bring this vision to life, he founded Framework Computer, Inc. in January 2020 and sought investors who shared his belief in a better laptop design. He also recruited fellow hardware engineers and software engineers to bring the first Framework laptop alive. In the years that followed this team only grew.

In the Netherlands, we have around 8,3 million households (Centraal Bureau voor de Statistiek, n.d.). There are almost no academic research papers on how much consumers spend on electronics and gadgets each year, however US PIRG a research group did research about e-waste in American households and we can extrapolate this information and presume that this is the case for all Western households. In The Netherlands each household consists on average of 2,12 people, this also includes people who are living alone (Centraal Bureau voor de Statistiek, n.d.).

Each household spends, on average, 1,400 euros on electronics every year. People often buy gadgets that don't last very long because everyone wants the latest phone or device. As a result, the old devices often get thrown away or forgotten in a drawer. Only a few people recycle their old devices, like giving an old phone to a family member, friend, or second-hand shop. Continuously discarding old devices and buying new ones wastes a lot of resources, which is terrible for the environment (United States Public Interest Research Group, Inc., 2021).

Based on the information above, we can estimate that a typical person in the Western world spends about 660 euros on electronics (including gadgets and household appliances) every year.

More than 50 million metric tons of e-waste is generated globally every year, averaging some seven kilograms of e-waste per capita. E-waste comprises 70% of our overall toxic waste. Only 12.5% of E-Waste is recycled.

In 2020, 10.3 kilos of electrical and electronic equipment waste were collected per inhabitant in the EU. According to an EU statistics report
https://www.eumonitor.eu/9353000/1/j9vvik7m1c3gyxp/vleugskinhty?ctx=vjxzjv7ta8z1

https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Waste_statistics_-_electrical_and_electronic_equipment

According to the EU commission this figure is only increasing every year. Around 53.6 million metric tons of e-waste is produced every year worldwide, according to the UN

https://www.weforum.org/agenda/2023/03/the-enormous-opportunity-of-e-waste-recycling/

The German bureau of statistics also affirmed and said that in 2020, approximately 4.7 million tons of electrical and electronic equipment waste was discarded. This equates to 10.5 kilograms per capita.
https://www.destatis.de/Europa/EN/Topic/Environment-energy/E_Waste.html

3. Technologies

I am writing this analysis with the aim of presenting an ethical research report tailored for a general audience, many of whom may have little to no technical knowledge. Please bear in mind that I will first summarise it for the technical audience and after that I will try to explain it to the general audience.

Laptops in general are used for work, study and entertainment. A laptop consists of hardware, firmware (specialised software for individual hardware parts, like lights on a keyboard) and software. Almost all Framework laptops uses proprietary UEFI firmware, InsydeH2O by Insyde Software, except for their 12th Gen Intel Core Chromebook Edition which uses coreboot (which is an open source project) as UEFI and all laptops use an open sourced embedded controller firmware based on CrOS EC (Chromium OS Embedded Controller). Framework Computer, Inc. has open sourced their EC firmware and announced this on 21 January 2022. In addition Framework is currently testing their Linux Vendor Firmware Service (LVFS) with a tool called fwupd. For those keen on tech details, this helps in updating the firmware under Linux (LVFS, 2022).

https://community.frame.work/t/timeline-of-generational-changes/31220

The house analogy

Foundation and structure: The physical structure of the house, including its walls, foundation, and roof, represent the hardware of your computer. This includes components like the processor, memory, and hard drive. These elements give the house its shape and protect it from external elements.

Front door lock: The UEFI (Unified Extensible Firmware Interface) can be likened to the lock on the front door of the house. Before you can enter your house and enjoy its features, you need to unlock the door. Similarly, before your computer fully starts up, the UEFI 'unlocks' the system, checking that everything is in order and safe. It ensures that there are no intruders (like malicious software or unauthorised processes) getting in when it unlocks.

Turning on the lights: Once inside, the first thing you'd typically do is turn on the lights to see and use the space. This act is like the bootloader of your computer's operating system taking charge after the UEFI's checks. The bootloader lights up the system, making it ready for you to use, loading the operating system, so you can use the applications you're familiar with.

Interior and ambiance: The decor, furniture, and general ambiance of the house represent the software and operating system of your computer. These components make the house livable and functional, similar to how software allows you to perform tasks on your computer.

In essence, when you turn on your computer, it's like approaching your house. The **UEFI** checks the lock, ensuring everything's safe and in place. Once that's assured, the door opens, you step inside, and the **bootloader** "turns on the lights", setting the stage for you to use the space (or in the computer's case, the software).

Not everything is open source

Framework has addressed the issue that their UEFI is not open source, Mr. Patel (2021), the founder and CEO of Framework, has collaborated on why this is the case *"Yep, open source firmware is well aligned to our mission of building products that are better for people and the planet. Our EC firmware is based on chromium-ec, and we will be releasing source. As @Kieran_Levin noted, we're also exploring coreboot. We're currently focused on getting the Framework Laptop out into the world in a lower-risk path that uses an off the shelf proprietary BIOS, but we're looking forward to replacing that with an open alternative in the future."*

In the above quote Mr. Patel is also referring to Kieran Levin, the "Lead System Architect" of Framework in that discussion.

This essentially means that shipping a workable laptop with ready made UEFI has priority, so Framework can get financial stability and grow market share, and in the meantime Framework is able to research and develop a coreboot solution at a later time. The project maintainers have told the Framework community it's the hardware manufacturer's responsibility to make this work and that they can only advise and help them. The coreboot project even maintains a list of contractors who specialise in coreboot development.

https://community.frame.work/t/responded-coreboot-on-the-framework-laptop/791/4

https://community.frame.work/t/responded-coreboot-on-the-framework-laptop/791

https://www.coreboot.org/vendors.html

https://www.coreboot.org/consulting.html

4. Stakeholders

There are two different stakeholders in every project and/or activity. Parties who are directly involved and have a direct relationship and interest in the project and/or activity. And there are parties who are indirectly involved. This report will analyse both.

Parties directly involved

Framework Computer, Inc. abbreviated as Framework, who is directly involved as a company. They are directly involved, because they are the seller and hardware manufacturer/designer of the Framework laptops and components.

Framework as a private company has shareholders and investors and this will undoubtedly set the company up as profit first, however the founder and CEO is one who has a vision of repairability, upgradability, customisability in mind and in turn make their products more sustainable and better for the environment. The problem is that legally the corporation is not set up like a B corporation (B stands for Benefit corporation), which have not only profit as it's fiduciary duty of the board of directors but also include making a positive impact on society. If the founder disappears for whatever reason then this corporation could turn into a classical one where profit is the only priority and then we're back to square one. There are no legal protections whatsoever to prevent a change like this. Maybe I'm wrong, but since Framework is a private company and Framework hasn't published their articles of incorporation on their website, we simply don't know how the company's legal structure is and what kind of protections are in place.

Other parties directly involved are the consumers who buy Framework laptops and components. As customers give money in exchange for products they want, the company has an incentive to listen to their customers, so in turn the happy customers do word of mouth advertising.

Parties indirectly involved

Suppliers and/or vendors who provide hardware chips and parts to Framework. Investors and/or shareholders are also indirectly involved. Framework does the designing of hardware with certain partners and uses some standard parts from creditable partners like Intel (for CPUs and wifi cards), AMD (for CPUs and GPUs) and others like Realtek (audio chips).

Previously Framework was shipping the mainboard and subassemblies from China. With the 12th Gen Intel Core version of the Framework 13 Laptop, the mainboard and major subassemblies are also made in Taiwan too. Making everything in Taiwan makes sure that Framework has better control over the production process and might even reduce the risk of supply interruptions. The manufacturing happens in Taiwan at the site in Taoyuan, Taiwan and their partner is Compal Electronics, Inc. who has decades of experience making laptops for other companies such as Dell and Lenovo.

The relationship between OEM (Original Equipment Manufacturer) and ODM (Original Design Manufacturer) is very critical for the success of the OEM. In this case Framework is the OEM and outsources some or most parts of the manufacturing to the ODM, which is Compal who has the factory plants and experience to make Framework's design a reality.

https://frame.work/nl/en/blog/manufacturing-starts-on-the-new-framework-laptop-in-taiwan

https://www.seacomp.com/resources/oem-vs-odm-manufacturing

5. Norms and values

In this ethical research report we will delve into the different norms and values we see here at play. Understanding the foundational norms and values of Framework and its customers is crucial in our ethical examination. These elements not only dictate the behaviour of the company and its consumers but also reflect larger societal standards.

Norms

Norms depict shared expectations and standards within a community or organisation. For Framework and its community of users, these can be summarised as:

- **Transparency:** Framework places a high premium on transparency. They are forthright about every aspect of their operations, from their manufacturing processes to the open-source nature of almost all the firmware and software used in their laptops. This commitment ensures that customers are fully informed about the origins and methods of their laptops' production.
- **Responsibility:** Framework's emphasis on reducing electronic wastage aligns with broader societal expectations of resource conservation and sustainability.
- **Autonomy:** By promoting repairability, upgradability, and customizability, Framework is championing a norm where consumers should have control over the technology they own, mirroring societal calls for reduced obsolescence and wastefulness.
- **Ethical business practices:** Framework exemplifies ethical business conduct by openly sharing details about their firmware. While much of their software is open

source, they maintain transparency by explaining why only their UEFI remains proprietary. They also discuss the possibility of open sourcing it in the future. This level of openness and clarity aligns with societal standards for business integrity and ethical operations.

Values

Values embody the deeply-held beliefs that motivate decisions and actions. For Framework and its user base, these essential values are:

- **Honesty:** An unwavering commitment to truth and integrity in all operations, resonating with a broader societal value of trustworthiness.
- **Sustainability:** Embracing environmental stewardship and long-term planning, echoing global calls for greener business practices.
- **Consumer empowerment:** Values like repairability, upgradability, and customizability highlight a focus on giving power back to the consumer, reflecting societal demands for products that offer value and longevity.
- **Fairness:** By being transparent and open about their operations, Framework aligns with societal values of equity and justice.
- **Ownership & autonomy:** Framework's value of real ownership reflects a larger societal trend where consumers are demanding more control over their purchased products.
- **Responsibility:** Acknowledging their role and impact on society and the environment aligns with larger societal calls for corporate accountability.
- **Collaboration:** Building on societal values of community and cooperation, Framework values partnerships and feedback, ensuring they are continually adapting and improving.

6. Impact (micro, meso and macro)

The introduction of Framework's easily repairable and modular laptops not only challenges the tech industry's norms but also has implications at various levels: micro (individual level), meso (community/organisational level), and macro (societal and global level). Let's delve into the impact at each of these levels below.

Micro:

- **Consumer empowerment:** Framework's focus on repairability and upgradability offers a fresh perspective to individual consumers. Rather than feeling compelled to throw away devices that aren't working perfectly, they now have the choice to repair or upgrade them. This approach not only results in cost savings but also instils a deeper sense of ownership.

When consumers realise they can extend the life of their devices, it fosters a mindset of value and longevity.

- **Environmental Awareness:** Choosing to repair or upgrade has broader implications than just personal benefits. Every time a consumer opts for these choices, it reduces the demand for brand-new devices. This, in turn, lessens the environmental impact associated with manufacturing and disposing of tech products. Furthermore, it aids in conserving the rare minerals and limited resources that are frequently used in electronic production.

  Being a part of the Framework community amplifies this consciousness. Members become more informed about e-waste challenges and the larger effects of their buying choices on the environment.

- **Skill development:** The modular design of Framework's products encourages individuals to delve deeper into the hardware components of their devices. Traditionally, many people have been apprehensive about opening up their electronic devices due to fears of damaging them or voiding warranties. This hesitancy often prevents them from acquiring hands-on technical skills. However, Framework's approach demystifies this process, fostering a DIY culture. As individuals become more comfortable with the idea of repairing or upgrading their devices, they not only save costs but also enhance their technical skills, gaining a deeper understanding of the technology they use daily.

  This newfound confidence can be transformative. For some, what starts as a simple act of replacing a component might ignite a passion for repair work, leading them to become professional repairmen or delve into other DIY projects. It's a ripple effect; once someone discovers their capability in one area, it can spark curiosity and drive in others. Such individual transformations, when multiplied across a community, have the potential to start a larger movement towards self-reliance and sustainability.

Meso:

- **Shift in business practices:** The potential for change through Framework's approach largely depends on more people having access to and choosing their products. Right now, the tech industry's move towards making devices that are sustainable and easy to repair is still in the beginning stages. Only a few companies, like Framework and Fairphone, are leading this change. Even though they're growing, they still make up a small part of the market. For a big change in the industry, these easy-to-repair devices need to be both more affordable and more widely available. Additionally, we need more companies to start making devices with these values in mind. As Framework laptops and similar products become easier to get and more affordable,

and as more companies join in, more people will start choosing these products.

This growing demand, fueled by more choices and better availability, will provide a strong incentive for the larger tech industry to change their ways. It's not just about a couple of companies doing things differently; it's about the entire market changing because of what people want and choose.

- **Community building:** The open-source approach adopted by Framework for both hardware and software components is a game-changer. It not only allows for transparency and customization but also actively encourages a community of enthusiasts, developers, and innovators to contribute and adapt the product to their unique needs. For instance, the open design of the extension ports means that anyone can create their own modules, leading to a plethora of innovative add-ons and functionalities.

  Additionally, the ease with which the motherboard (called the mainboard) can be removed from the laptop chassis offers users the flexibility to repurpose or integrate it into different setups, tailored to their specific requirements. This level of adaptability and community involvement ensures that the product is continually evolving, driven by the collective creativity and expertise of its user base.

- **Economic implications:** As more consumers adopt the mindset of repairing and upgrading, businesses related to tech maintenance and parts supply could see a surge in demand. Instead of consumers immediately opting for a new device when faced with an issue, there might be a growing trend towards seeking repairs or upgrades. This could lead to a potential boost for local repair shops and parts suppliers, while also promoting a more sustainable economic model in the tech industry.

Macro:

- **Reduction in e-waste:** Modular designs, like those championed by Framework, have the potential to significantly reduce global e-waste. By making devices that can be easily repaired and upgraded, we can address one of the most pressing environmental challenges of our time. The key to this shift lies not just in companies adopting these designs, but also in the collective demand of consumers.

  As more people opt for sustainable tech choices, it sends a clear message about the kind of products they want to see in the market.

- **Policy and regulation:** The growing popularity of sustainable devices can have a ripple effect on policy decisions. Regulatory bodies and lawmakers, such as the EU Parliament and US Congress, take note of public sentiment. As consumers voice their

preferences, backed by actions like protests and petitions, it can drive these institutions to implement policies that support sustainable tech practices.

The success of companies like Framework and Fairphone can serve as a catalyst, encouraging policymakers to support movements like the 'right to repair', leading to regulations that prioritise repairability and upgradability in tech products.

- **Ethical production:** With consumers demanding transparency and sustainability, there could be a push towards more ethical production practices across the tech industry, benefiting workers and the environment. And also a significant reduction in child labour.

In conclusion, Framework's modular approach to laptops has the potential to create ripples of positive change across various levels. From empowering individual consumers to influencing global tech practices, the impact is profound and far-reaching.

7. Conclusion

Example text

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